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(58) Field of Search
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(54) Abstract Title
Vehicle body assembling method

(57) A vehicle body is constructed from metal roof 10, side 12,14 and floor 16 fabricated panels. The roof 10 and two side panels 12,14 are first joined to form a sub-assembly and thereafter the sub-assembly is fitted around floor panel 16. Corresponding flanges 24,26,28,30 along the edges of the floor 16 and side 12,14 panels are welded or otherwise joined together. The sub-assembly of roof and side panels 10,12,14 is formed using a flaming station having location and clamping tools for the two side panels 12,14. The tooling or sub-assembly or both may be moved to allow the sub-assembly to be moved to another workstation. The flanges 24,26 on the floor panel 16 may be formed as a final manufacturing step prior to its assembly with the sub-assembly. A flanging machine for producing the flanges 24,26 on the floor panel 16 is also disclosed.

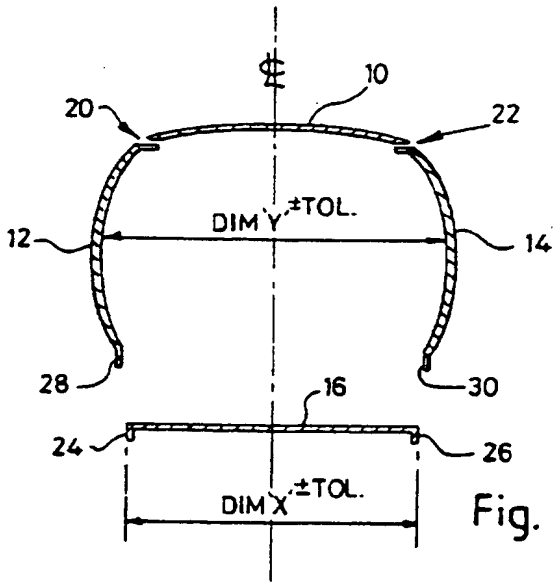

Fig. 2

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1995

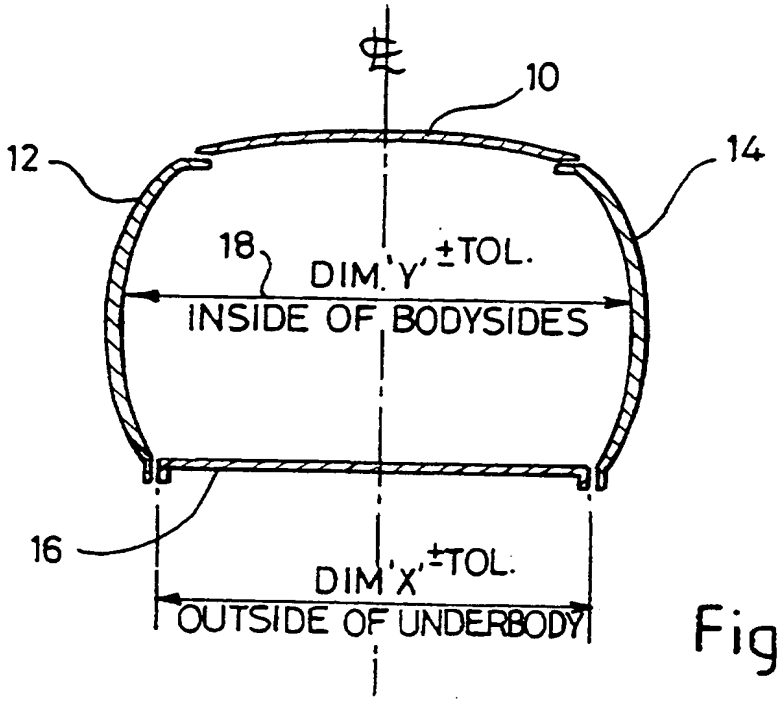
10
12
14
18
DIM 'Y' ±TOL.
INSIDE OF BODYSIDES
16
DIM 'X' ±TOL.
OUTSIDE OF UNDERBODY

Fig. 1

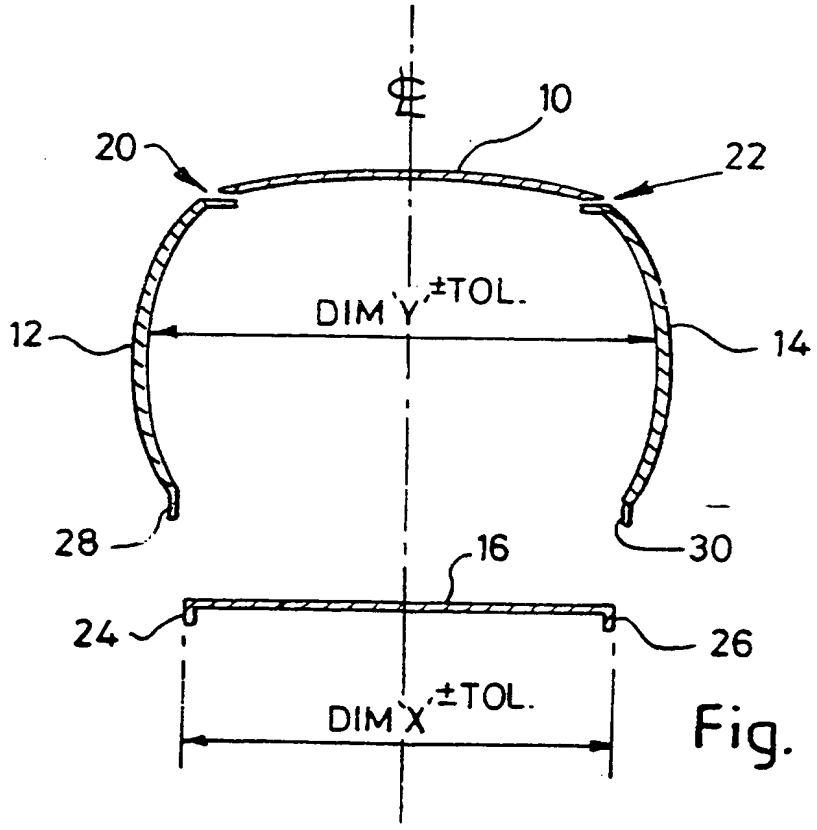
10
20
22
DIM 'Y' ±TOL.
12
14
28
30
16
24
26
DIM 'X' ±TOL.

Fig. 2

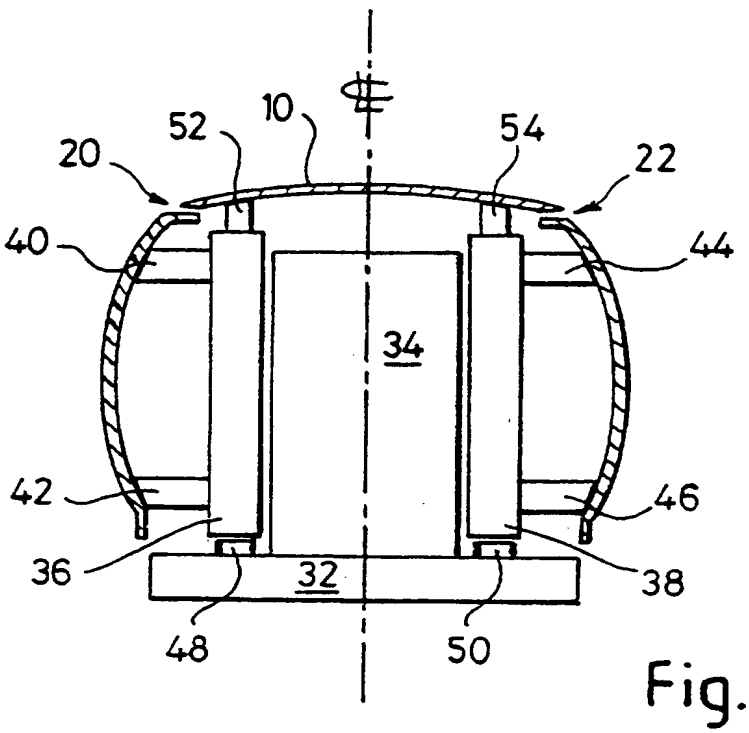

Fig. 3

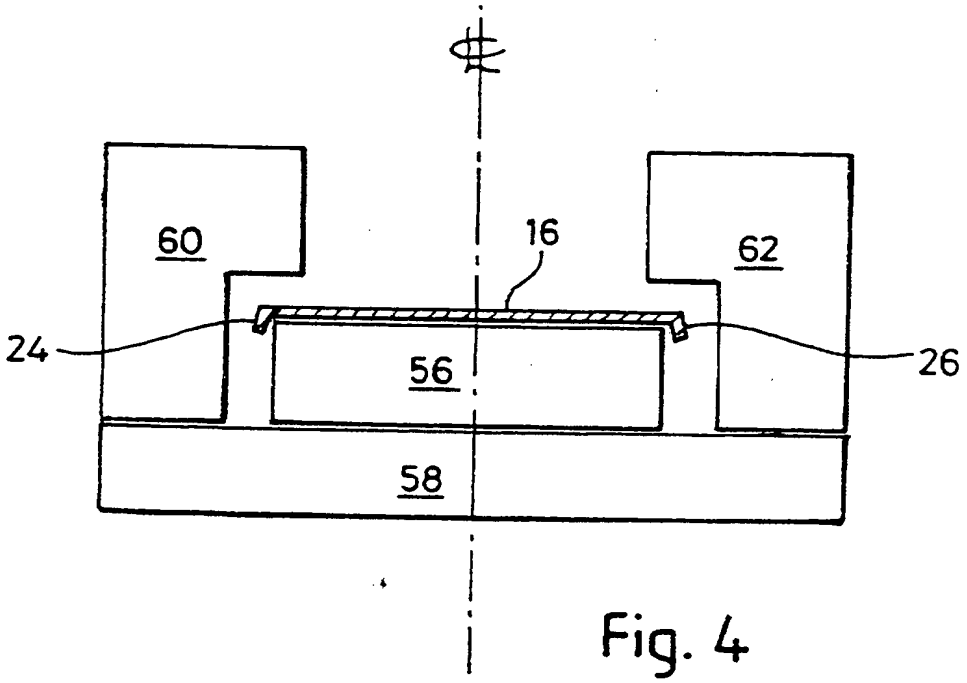

Fig. 4

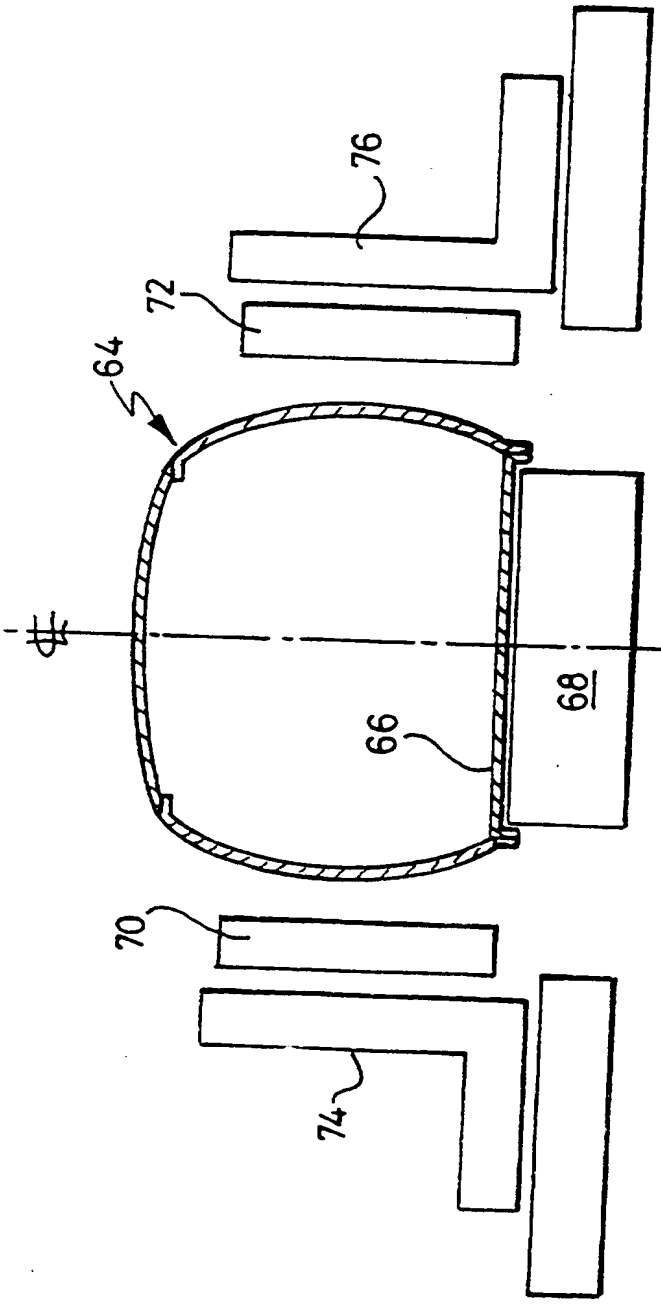

Fig. 5

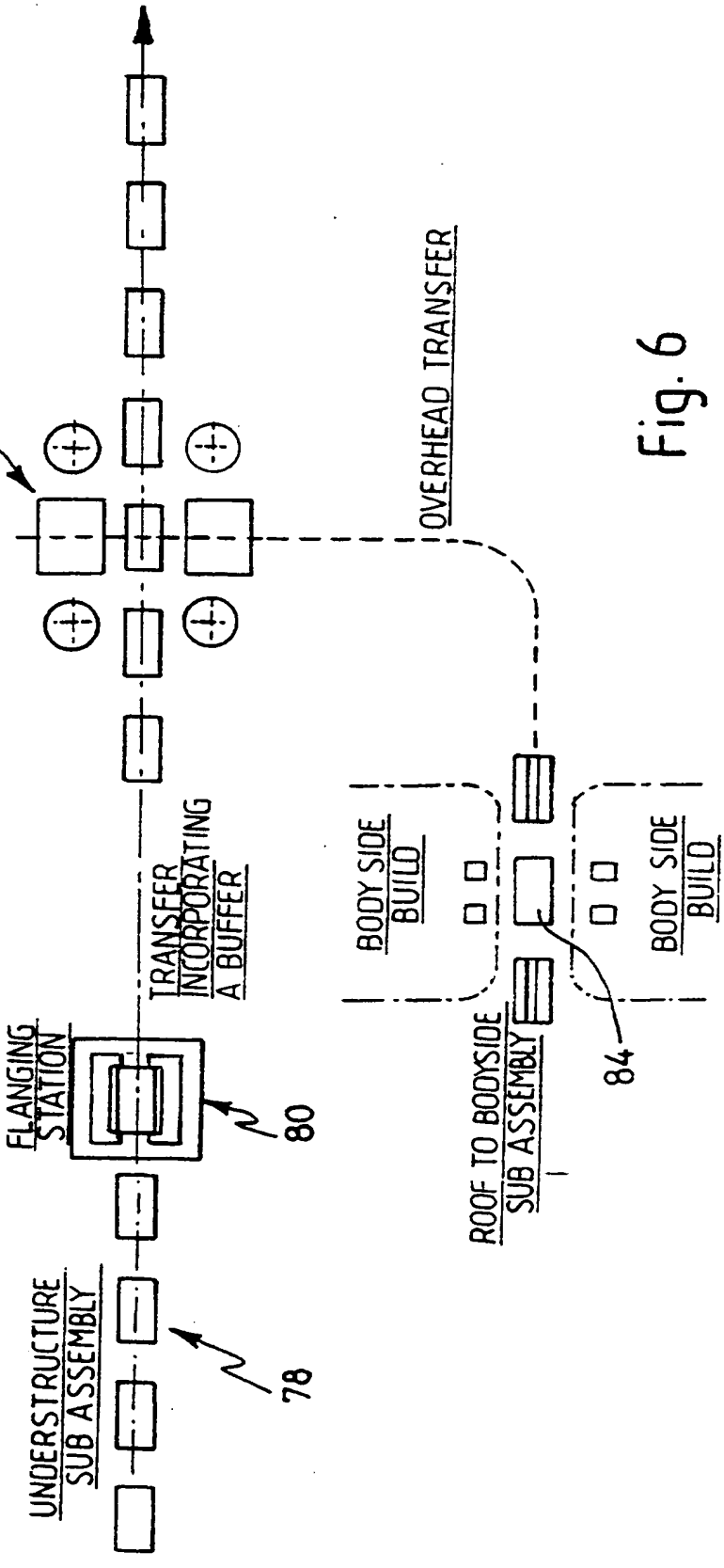
UNDERSTRUCTURE SUB ASSEMBLY
78
FLANGING STATION
80
TRANSFER INCORPORATING A BUFFER
FRAMING
82
OVERHEAD TRANSFER
BODY SIDE BUILD
ROOF TO BODYSIDE SUB ASSEMBLY
84
BODY SIDE BUILD

Fig. 6

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C466/W

Title: Vehicle body assembly

Field of invention

This invention concerns the assembly of metal fabrications to form vehicle bodies and the like.

Background to the invention

It is known to fabricate side panels, floor panels and roof panels and to bring left and right side panels together with a floor panel and roof panel into a jig assembly for welding overlapping peripheral edge regions of the fabrications, to form a body shell for a motor vehicle or the like.

The floor panel fabrication essentially comprises a relatively flat sheet metal structure with opposite edges turned down to form flanges which are available for spot welding to similar parallel flanges along the bottom edges of the two side panel fabrications. Although the floor panel is essentially a generally flat structure, in fact in order to give strength and rigidity to the floor panel, it is typically formed with recesses or upstanding areas formed by bending and forming the sheet metal and each such operation tends to alter the overall dimensions of the sheet and each such dimensional change has to be accommodated within the initial dimensions so that after all the bending and folding has been completed, the width of the floor panel fabrication is equal to the required spacing between the lower edges of the two side panel fabrications.

Increasingly there is a desire to better control the internal dimensions of an assembly of prefabrications such as described since this will facilitate the fitting of interior trim parts to the final structure.

Summary of the invention

According to one aspect of the present invention, instead of welding four fabrications whilst loosely held in a jig assembly (framing buck) during a single welding operation, it is now proposed that three of the fabrications (the roof panel and the two side panels) should be welded to form a first sub-assembly and only after this sub-assembly has been constructed is it fitted around a floor panel fabrication for welding to opposite sides thereof.

Although the invention is described exclusively herein with reference to downturned peripheral edges of the floor tray fabrication, it is to be understood that the expression downturned can equally include upturned, if the floor tray design dictates that this is more appropriate, and flanged apparatus described herein is equaly capable of bending the floor tray edges up or down as required, merely by modifying the cooperating tooling surfaces.

Likewise it is to be understood that reference to welding herein can also mean any form of material joining or bonding or adhering technique.

According to a preferred feature of this aspect of the invention, the first fabrication involving the roof and side panels can be constructed using internal tooling for holding the fabrication accurately and precisely in position relative one to the other instead of relying on external tooling which is essentially all that is available if the floor panel fabrication is to be located in the jig, and secured to the side panels at the same time as the roof panel, is secured thereto as in more conventional framing arrangements.

By using internal tooling the internal spacing between side panel fabrications can be controlled very accurately which is a first step to accurately controlling internal dimensions of

the passenger and engine compartments of a motor vehicle body assembly.

In one embodiment, the first sub-assembly of roof and side panel fabrication may be created by a single or multistation fabrication machine that incorporates left and right hand tooling plates which carry the required location and clamping the tooling. The tooling plates may be either fixed or interchangeable and may be manually or automatically removable. Since the side panel fabrications tend to be concave when viewed from the inside of the vehicle body, it is preferable for the tooling plates to be movable or collapsible in a direction away from the side panel fabrications which they support during the construction of the sub-assembly so as thereby to space the tooling from the internal walls of the sub-assembly to produce a clearance between the tooling and the side panels to allow the tooling to be extracted from the sub-assembly or the sub-assembly to be extracted from the tooling.

Typically the sub-assembly is lifted from the tooling since the clear space through which tooling can pass is essentially the underside of the sub-assembly which will eventually be closed by the floor panel fabrication.

According to another feature of this aspect of the invention, joining the roof panel to the side panel fabrication may be achieved either manually or automatically and where automatic welding is performed, this may be from either the inside of the sub-assembly or from outside.

According to another feature of this aspect of the invention, an overhead hoist is preferred which may be manually or automatically operated.

Depending on the clearance, it may not be necessary to lift the sub-assembly off the tooling, by more than what is necessary to allow the upper end of the tooling to clear the rear parcel

tray, or bulk head if fitted at that stage, (in the event of a saloon model). Where the final vehicle is a 3 or 5-door hatchback or estate-type vehicle, the amount by which the sub-assembly has to be lifted may be minimal since the tailgate region of the vehicle body will be entirely open at that stage.

According to another feature of this aspect of the invention, the sub-assembly may be supported by a hoist without elevation and the tooling retracted first laterally so as to allow for good clearance between the tooling and the inside surfaces of the side panels of the sub-assembly, and thereafter lowering the tooling by a sufficient distance relative to the suspended sub-assembly to allow the latter to be moved substantially horizontally along the transfer line to the next fabricating workstation step.

According to a still further feature of this aspect of the invention, both tooling and sub-assembly may be moved so as to produce the desired clearance to allow the sub-assembly to be moved to the next workstation.

According to another aspect of the present invention, a floor panel sub-assembly for securing to a first sub-assembly formed from a roof and two side panels, which with the floor panel will together form at least the passenger and engine compartments of a motor vehicle body, is formed along its two lateral edges with downturned flanges as a final or substantially final manufacturing step prior to its assembly with the side panel and roof sub-assembly ready for welding the adjoining flanges.

The advantage of this aspect of the invention is that by waiting until the last or substantially the last operation to form the two downturned edges of the floor panel, it is possible to control the dimension between the outside surfaces of the two downturned edges much more accurately than if these are formed at an earlier stage in the fabrication of the floor

panel, to be followed by other sheet metal operations which may alter the final spacing between the two downturned edges.

It is to be understood that the two lateral edges of the floor panel may be partially downturned prior to final flanging so that the flanges are effectively formed in two steps.

A Landis Tool STO. flanging machine is preferably utilised for flanging the floor panel.

In general terms the flanging machine comprises an anvil tool on which a floor panel can be deposited so that it is symmetrically positioned thereon with edge regions overhanging the anvil by an equal amount on opposite sides, and two forming tools mounted on opposite sides of the anvil tool and movable under power towards the anvil from the two opposite sides thereof to engage and bend down the two overhanging regions of the floor panel fabrication so as to form two downturned flanges which in their final configuration, will become trapped and compressed between the two tools and the anvil, one flange being located between the anvil and each tool.

Typically the anvil and the two laterally movable tools are carried by a base and the latter conveniently houses pneumatic or hydraulic rams for effecting the inward and outward movement of the tooling to effect the flanging, and subsequent removal of the floor panel.

In order to reduce the amount by which the lateral tooling has to be moved outwardly so as to permit the floor panel to be moved from the anvil, a transfer mechanism is preferably provided which essentially moves the floor panel horizontally onto, and horizontally off, the anvil tool with only minimal vertical elevation. The floor panel after flanging can therefore be removed from the flanging machine even if the two flanging tools still overhang the opposite side edges of the flange floor panel, provided sufficient clearance exists

between the downturned edges and the tooling to permit the flanged floor panel to be slid horizontally off the anvil tool.

According to a preferred feature of this aspect of the invention, the anvil tool may itself be temporarily displaceable in a downward direction so as to facilitate the transfer of fabricated floor panels into and out of the flanging station.

According to another feature of this aspect of the invention, the anvil tool may itself form part of a transfer mechanism which is adapted to receive an unflanged floor panel at one end, transfer the fabrication into the flanging station, act as the anvil tool for the flanging operation and then shift the flanged fabrication clear of the flanging slanging so as to be capable of being transferred onwardly down the line.

According to a still further feature of this aspect of the invention, the transfer mechanism may comprise a form of walking beam assembly and the anvil tool may comprise a fixed lower member within the flanging station onto which unflanged floor panels are transferred on the one hand and from which they are transferred on the other by two walking beam transfer mechanisms, one upstream and the other downstream of the flanging station.

By performing the flanging operation towards the end of the machining steps which are necessary to form the floor panel fabrication, the final dimension between outside edges of the two downturned flanges can be controlled to a very high tolerance thereby ensuring that the internal dimensions at least from side to side within the passenger compartment and the engine compartment of the final assembly will likewise be accurate and consistent.

According to a further aspect of the invention, in a method of assembly of a vehicle body shell from a first sub-assembly

(comprising pre-joined roof and side panels) and a second sub-assembly comprising a pre-formed and flanged floor panel, the first sub-assembly is engaged by external tooling mounted on gates which are movable towards and away from the external surfaces of the two side panels for welding a flanged lower edge of each of the two side panels to the cooperating flanged edges of the floor panel fabrication as by welding whilst the floor panel is itself carried by an anvil and is accurately located relative to the two gates. Any bowing or non-squareness of the first sub-assembly will thus be compensated and largely eliminated by the action of squaring the side panels relative to the tooling on which the floor panel is supported and only thereafter welding the lower edges of the side panels to the downturned edges of the floor panel whilst the assembly is maintained square and true.

The first sub-assembly (roof and side panels) may be transferred in an elevated mode and lowered into the final framing position between the gates on either side of the floor panel carried by the lower tooling or anvil, and the floor panel fabrication may be transferred into the final framing station by means of a transfer mechanism such as described above.

Alternatively the floor panel and first sub-assembly may be transferred into the final framing station substantially horizontally and either in a generally converging or parallel sense by means of appropriate transfer conveying means.

The tool carrying gates on opposite sides of the framing station may be carried by supports which allow for movement of the gates towards and away from the framing station and also permit rapid mounting and demounting of such tooling gates to allow for inter-changeability between different pairs of tooling gates depending on the vehicle model proceeding down the line.

In exactly the same way the floor panel tooling may also be interchangeable to accommodate different floor panel configurations, again depending on the model of vehicle being built at the time.

The invention will now be described, by way of example, with reference to the accompanying drawings.

In Figure 1 the roof or roof supports 10 of a vehicle body passenger compartment is shown nesting on the opposite upper edges of left and right hand body sides 12 and 14 and an underbody fabrication 16 is shown nested between the lower edges of the two sides 12 and 14 ready for welding. In a conventional framing station the welding between the roof or roof supports 10 and the two sides 12 and 14 and between the lower edges of these and the underbody 16 are all performed at the same time. As a consequence, in general, the tooling used to secure and position the side panels and the roof and underbody have to be external to the compartment generated by the joining together of these various fabrications, and it is difficult to maintain to a high level of accuracy and consistency the internal dimensions of the body shell so formed, particularly the dimension shown at 18, namely between opposite internal faces of the two body sides 12 and 14.

Figure 2 illustrates the alternative approach proposed by the present invention in which two sub-assemblies are formed, the first comprising a roof panel 10 joined to side panels 12 and 14 along the cooperating edges 20 and 22, and a floor panel 16 having downturned edges forming joining flanges at 24 and 26 respectively for welding to the lower edges 28 and 30 of the two side panels 12 and 14 respectively.

Figure 3 illustrates how the roof and side panel of the first sub-assembly can be held in position immediately before welding between the cooperating edges 20 and 22 by means of internally located tooling carried by a base 32 and central upstanding

support 34 carrying tooling gates 36 and 38 with internally engaging tooling at 40 and 42 on tooling gate 36 and at 44 and 46 on tooling gate 38. The central core or spine 34 allows for inward and outward movement of the tooling relative to the tooling gates 36 and 38 and/or inward and outward movement of the tooling gates themselves.

The tooling such as 40 and 42 not only clamps to the side panel fabrications but also serves to locate them accurately relative to one another and to the roof panel 10.

Removal of the fabricated sub-assembly is achieved by retracting the tooling and/or tooling gates or both so as to be well clear of the two side panels of the sub-assembly and either lifting the sub-assembly or lifting and sliding the sub-assembly clear of the tooling.

To facilitate movement of the sub-assembly solely in a horizontal mode without the need for significant elevation, the tooling gates 36 and 38 may be elevated relative to a pair of stops at 48 and 50 to enable tooling at 52 and 54 to engage the underside of the roof panel 10 prior to the joining of the roof panels and side panels. After the joining has been completed, the tooling 52 and 54 may be withdrawn in a downward sense and/or the tooling gates 36 and 38 lowered so that if the sub-assembly is supported independently of 52 and 54 as by means of a hoist, the retraction of the tooling 52 and 54 or tooling gates 36 and 38 from the underside of the roof panel 10 means with similar retraction of tooling 40, 42, 44 and 46 respectively, the sub-assembly can simply be slid in the form of a railway carriage in a horizontal mode perpendicularly into or out of the page as shown in Figure 3.

In order to control the lateral internal spacing between side panels and maintain this accurately, it is necessary for the floor panel 16 to have an accurate dimension between the external faces of the two downturned joining edges or flanges

24 and 26 shown in Figure 2.

In accordance with the appropriate aspect of the invention, these flanges are only formed after the floor panel has been fully or significantly pre-fabricated so that there is no tendency for any variation to occur in the dimension between the two external surfaces of the two downturned flanges 24 and 26. To this end, the flooring panel 16 is shown carried by a lower tooling or anvil 56 itself carried by a base 58 in Figure 4, which illustrates a flanging station based on a Landis Tool STO flanging machine.

On opposite sides of the anvil 56 are mounted movable flanging tools 60 and 62 and hydraulic or pneumatic drive means is mounted within the base or otherwise convenient so as to effect inward and outwards movement relative to the anvil 56 of the two tools 60 and 62 to engage and downturn the overhanging edges of the floor panel 16. As shown the edges are shown partially downturned at 24 and 26 but it will be seen that by moving the two flanging tools 60 and 62 in an opposite sense inwardly towards the anvil 56, and raising the anvil 56 simultaneously, so the two overhanging and partially downturned edges 24 and 26 of the floor panel 16 will become trapped and nested between the external edges of the anvil and the internal corners of the two tooling members 60 and 62, so that with the final movement of the anvil and tooling the two edge regions are fully turned down and the dimension is controlled very accurately by virtue of the anvil 56.

Figure 5 shows a framing station in which the sub-assembly 64 and flanged floor panel 66 are located ready for welding or otherwise joining between the two cooperating pairs of flanges. To this end the floor panel is carried by a transfer device containing interchangeable tooling 68 and interchangeable ring gates 70 and 72 are carried by supports 74 and 76 respectively for movement towards and away from the sub-assembly to engage and locate the side panel of the sub-assembly 64 as required.

Figure 6 illustrates a framing facility in which the floor panel fabrication is transferred from one stage to another along the transfer line 78 finally to a flanging station at 80 such as shown in Figure 4, and thereafter a transfer line incorporating a buffer transfers the flanged flooring trays into a framing station with interchangeable gates generally designated 82. The roof and side panel sub-assemblies are formed in the main assembly station generally designated 84 and transferred by overhead transfer into the framing station 82.

CLAIMS

1. In a method of constructing a vehicle body from metal roof, side and floor panel fabrications by welding or otherwise joining whilst loosely holding the fabrications in a jig, the roof panel and two side panels are welded or otherwise joined to form a sub-assembly and thereafter the sub-assembly is fitted around a floor panel fabrication and welded or otherwise joined to opposite sides thereof to form the vehicle body.

2. A method as claimed in claim 1, wherein during the welding of the sub-assembly of the roof and side panels, internal tooling is employed for holding the fabrications, relative one to the other.

3. A method as claimed in claim 1 or claim 2, wherein the internal spacing between the side panel fabrications is controlled accurately by holding the two side panels using internal tooling.

4. In a method as claimed in any of claims 1 to 3, the sub-assembly of roof and side panels is formed using a framing station which incorporates left and right hand tooling gates which carry location and clamping tooling for the two side panels, and which enter the assembly from below or from the front or rear end thereof.

5. In a method as claimed in claim 4, the tooling gates are removable.

6. A method as claimed in claim 5, in which each tooling gate is movable towards the other away from the side panel fabrications which they support during the construction of the sub-assembly, so as to space the tooling from the internal side walls of the sub-assembly before the tooling gates are

extracted therefrom.

7. A method as claimed in claim 4, 5 or 6, wherein the sub-assembly is lifted away from the internal tooling so that the latter passes through the open underside of the sub-assembly.

8. A method as claimed in any of claims 1 to 7, wherein the joining of the roof panel to the side panel fabrication is achieved manually or automatically.

9. A method as claimed in claim 8, wherein the joining process is performed automatically from either the inside of the sub-assembly or from the outside.

10. In a method as claimed in claim 1, the sub-assembly is supported at a given height at a first workstation along a transfer line and the tooling is retracted first laterally so as to create a clearance between it and the inside surfaces of the sub-assembly side panels, and thereafter downwardly by a sufficient distance relative to the sub-assembly to allow the latter to be moved along the transfer line to the next work station.

11. In a method as claimed in claim 1, both tooling and sub-assembly are moved so as to produce the clearance required to allow the sub-assembly to be moved to the next workstation.

12. In a method as claimed in any of claims 1 to 11, during the manufacture of the floor panel which is to be secured to the sub-assembly to form at least the passenger and engine compartments of a motor vehicle body, the floor panel is formed along its two lateral edges with flanges as a final or substantially final manufacturing step prior to its assembly with the said sub-assembly, whereby it is possible to control the dimension between the external surfaces of the two edges more accurately than if they were formed at an earlier stage in the construction of the floor panel.

13. A method as claimed in claim 12, wherein the flanges are welded or otherwise joined to corresponding flanges along the lower edges of the two side panels after assembly therewith.

14. A method as claimed in claim 12, wherein the two lateral flanges of the floor panel are partially formed prior to final flanging, so that the flanges are formed in two steps.

15. A flanging machine for use in the method of claim 12, 13 or 14, comprising an anvil on which a floor panel can be located so that it is symmetrically positioned thereon with edge regions overhanging the anvil by an equal amount on opposite sides thereof, and two forming tools mounted on opposite sides of the anvil and movable under power towards the anvil from opposite sides thereof, to engage and bend down the two overhanging regions of the floor panel fabrication, so as to form two downturned flanges each of which in its final configuration will be trapped and compressed between one of the forming tools and the anvil.

16. A flanging machine as claimed in claim 15, wherein the anvil and the two laterally movable forming tools are carried by a base and the latter houses pneumatic or hydraulic rams for effecting inward and outward movement of the forming tooling to effect the flanging and subsequently to remove the floor panel.

17. A flanging machine as claimed in claim 15 or 16 in combination with a transfer mechanism adapted to slide the floor panel substantially horizontally onto and off the anvil whereby after flanging, the floor panel is removable from the flanging machine while the two forming tools still overhang the opposite side edges of the floor panel, and wherein the forming tools retract away from the flanged edges of the floor panel after flanging to create a clearance between the panel and the tooling to permit the said sliding of the floor panel off the anvil.

18. A flanging machine as claimed in claim 17, wherein the anvil is temporarily displaceable in a downward direction to facilitate the transfer of fabricated floor panels onto and off the anvil.

19. A transfer line for a floor panel of a motor vehicle body which includes support means adapted to receive an unflanged floor panel to transfer the panel into a flanging station, serve as the anvil for the flanging operation in the flanging station, and then shift the flanged panel clear of the flanging station for onward transit down the line.

20. A transfer line for a floor panel of a motor vehicle body which comprises a first walking beam, a flanging station which includes a fixed lower member in the form of an anvil onto which unflanged floor panels are transferred by the first walking beam, and a second walking beam by which flanged panels are transferred out of the flanging station, the two walking beams being located one upstream and the other downstream of the flanging station.

21. In a method of assembly of a vehicle body shell from a first sub-assembly comprising a pre-joined roof and two side panels, and a second sub-assembly comprising a preformed and flanged floor panel, the first sub-assembly is engaged by external tooling mounted on gates which are movable towards and away from the external surfaces of the two side panels and comprise a framing station, and the lower edges of each of the two side panels are welded or otherwise joined to flanged edges of the floor panel while the floor panel is itself carried by lower tooling which accurately locates it relative to the two gates, wherein bowing or non squareness of the first sub-assembly is substantially reduced by the action of squaring the side panels relative to the floor panel support before the lower edges of the side panels are welded to the flanged edges of the floor panel.

22. A method as claimed in claim 21 wherein a sub-assembly of roof and side panels is transferred in an elevated mode and lowered into the framing station between the gates on either side of the floor panel, which latter is carried by the lower tooling.

23. In a method as claimed in claim 21, the floor panel and the said first sub-assembly are transferred into the framing station substantially horizontally.

24. In a method as claimed in claim 21, the tool carrying gates on opposite sides of the framing station are carried on supports which allow for movement of the gates into and out of the framing station and also permit rapid mounting and demounting of the tooling gates to allow different tooling to be substituted, and the lower tooling is likewise interchangeable with other lower tooling to enable different vehicle/model side panels and floor panels to be accommodated.

25. Methods and apparatus for joining fabrications to form motor vehicle bodies substantially as herein described with reference to and as illustrated in the accompanying drawings.

The Patent Office

17

Application No:	GB 9716359.6	**Examiner:**	Phil Thorpe
Claims searched:	1-14,25	**Date of search:**	21 October 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): B7B BR

Int Cl (Ed.6): B62D 65/00

Other: ---

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	EP0512576A1	Mazda - see especially figures 21-24,29,51 and 53 and accompanying description	1-9
A	EP0240470A1	Fiat	---

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.